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Constant Bit Rate for Video Streaming Over Packet Switching Networks

Mr. S. P.V Subba rao[1], Y. Renuka Devi[2]
Associate professor SNIST(ECEDept.)
M. Tech(VLSI&ES) SNIST(ECE Dept.)

Abstract: *This paper proposed a technique of bit-rate control for video streaming over constant bit-rate communication channel, where the MPEG-2, standard variable bit-rate (VBR), is adapted to be used as a constant bitrate (CBR). The target image quality and by feedback based on the buffer level controlled on the output rate of the video encoder. A CBR transport over networks, result is a good performance compared with that of VBR. It introduced simplicity of network monitoring and analysis, where the VBR video streaming over CBR channel can be adapted to avoid the problem of congestion of the network. In this paper we study important issue of adapted VBR-compress the video for transport over a CBR channel. That developed systems are implemented using Matlab (Ver 6.5) under Windows XP operating system.*

I. Introduction

Multiple-Input Multiple-Output (MIMO) technology is a wireless technology, more data transfer at the same time we use the multiple transmitters and receivers. Multipath known as MIMO technology take the advantage of a radio wave phenomenon, where transmitted information is bounces off walls, ceilings and other objects, it reaches the receiving antenna multiple times via different angles and at slightly different times.

MIMO technology pull multipath behavior by using multiple, "smart" transmitters and receivers with an added "spatial" dimension to dramatically increase the range and performance.

Fig 1.1: MIMO Technology uses multiple radios to transfer more data at the same time.

At the same time, it allows multiple antennas to receive and send multiple spatial streams. That it makes antennas works smarter than by enabling them to combine data streams arrived from different paths and effectively increase the receiver signal capturing power at different times. Smarter antennas use spatial diversity technology, good use of which puts surplus antennas. If there are more antennas than spatial streams, the additional antennas can add to receiver diversity and increases the it's range.

In SIMO as two forms can be used as:

- **Switched Diversity SIMO:** This form of SIMO looks for the strongest signal and switches to that antenna.

Maximum ratio combining SIMO: This form of SIMO takes both sums of them to give a combination and signals. In this way, the signals from both antennas contribute to an overall signal. It has two main designs for MIMOs are given below:

• **Spatial diversity:** It often refers in this narrower sense to transmit and receive diversity we uses the spatial diversity. In these two methodologies are used to provide improvements in the signal to noise ratio and they are characterized by make better the reliability of the system with respect to the various forms of fading.

• **Spatial multiplexing:** This form of MIMO used to provide additional data capacity by utilizing the different paths to carry additional traffic, i.e. increasing the data output capability.

Favors of MIMO Technology

(1) To overcome the detrimental effects of multi-path and fading, we use multiple antenna configurations, when trying to achieve high data throughput in bandwidth channels are limited.

(2) Superior Data Rates, Range and Reliability.

II. Existing System

We addressed the problem of efficient bit allocation in a fixated on coding environment. While optimal bit allocation for independently coded signal blocks has been studied in the blurb, we extend these techniques to the more general temporally and spatially dependent coding scenarios, of particular interest are the topical MPEG video coder and multiresolution coders. Our approach uses an operational rate-distortion (RD) framework for arbitrary quantizer sets.

2.1 Disadvantages of Existing System

1. Low PSNR
2. Current frames are discarded

III. Proposed System

This paper proposed a technique of bit-rate control for video streaming over constant bit-rate communication channel, where the MPEG-2, standard variable bit-rate (VBR), is adapted to be used as a constant bit rate (CBR). Feedback based on the buffer level controls the target image quality and output rate of the video encoder. A CBR transport over networks, result is a good performance compared with that of VBR. These rate control schemes are usually resolve two main problems. First is how to allocate proper bits to each coding unit according to the buffer status, i.e., rate allocation, and the second is how to adjust the encoder parameters to properly encode each unit with the allocated bits i.e., quantization parameter adjustment. PSNR is relatively easy to calculate and provides a rough approximation to the visual quality of the video frame. a high PSNR indicates a high-quality frame.

3.1 Proposed System Advantages

1. These rate-control schemes usually objective of two main problems. First is rate allocation and the second is quantization, parameter adjustment.
2. High PSNR

IV. Video Compression

Video compression, which is a necessary process for video communication over networks, removes spatial and temporal redundancies contained in video sequences.

A decreasing in distortion leads to an increasing in rate and vice versa. So the fundamental problem in rate control can be stated that min D,

$$s.t. R \leq R_{max}$$

Where Rmax denotes the maximum bit rate. In other words, rate control is to achieve the maximum picture quality (minimum distortion) without exceeding the maximum permitted bit rate where quality is typically represented by peak signal noise ratio (PSNR). Raw video must be compressed before transmission because to achieve efficiency. Video compression schemes are classified into two categories: scalable and nonscalable video coding. Since scalable video is capable of fitly coping with the bandwidth fluctuations in the Internet, we are primarily concerned with scalable video coding techniques. We can also discuss the requirements imposed by streaming applications on the video encoder and decoder.

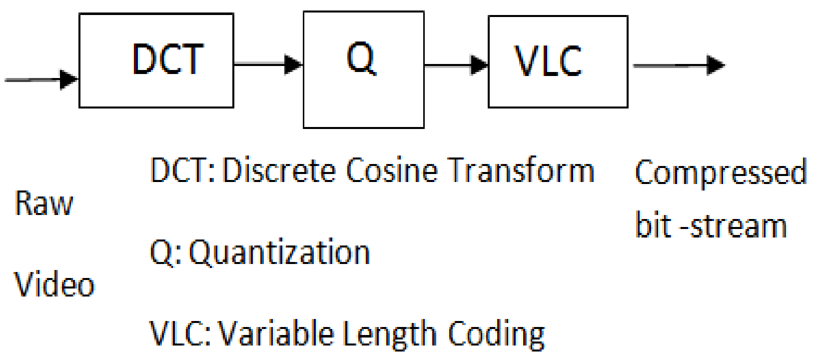

Fig 4.1: No scalable video encoder

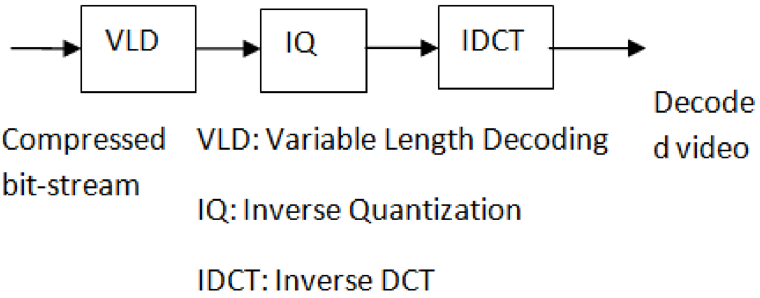

Fig 4. 2: No scalable video decoder

V. Rate Control Constrained Quality

Rate control always evolves into constrained problems in practical applications. Since the amount of information in compressed video sequences is inherently variable, a buffer is placed between the video encoder and the transmission channel to smooth out the rate variation. The proposed rate control algorithm is designed for bit-rate control includes the requirements of MPEG-2 video coding standard. The TM5 rate control algorithm is designed for bit-rate control in MPEG-2 video coding standard. It consists of the following steps:

(1) Target bit allocation: Target number of bits for the next picture depends on the picture-type and universal weighting factors.

(2) Rate control: The reference value of the QP for each macro block (MB) (Qj) is set as follows:

$$Q_j = (B_i * 31)/r$$

Where r =2 × R/*f*, **R** denotes the bit rate (bps), *f* denotes the frame rate (fps), for a constant quantization step size of 31, and Bj is the fullness of the buffer.

(3) Adaptive quantization: Finally, the QP for MB *j* is mquantj = Qj× N_actj and is clipped to the range, where N_actj is the normalized spatial activity measure for the MB *j*.

5.1 Mode Selection and Size Selection

In video coding, there are different frame types I, P, and B frames with different Macro Block (MB) modes.

VI. Frame Dropping Filter: Rate Shaping

The frame dropping filter is used to reduce the data rate of a video stream by discarding a number of frames and transmitting the remaining frames at a lower rate. Before removing the temporal redundancy from the current Inter-frame, it's compared with the previous frame and the difference is measured between them. If the difference is very small, the current frame will be discarded, and the next frame is used as the current frame. But in the receiver side, the discarded frame will be displayed by repeating the previous frame, (i.e. if we transmit 30 fps, and for example in the encoder side we discard two frames, then in the receiver side the number of frames that will be displayed are 32 frame, because the system was design to transmit 30 fps). But if there are no frames to discard, the number of frames displayed equals to the number of frames transmitted. The procedure of frame dropping is as follows:

Step 1: Determine the similarity between the frames.

Step 2: If the current frame is very similar to the pervious frame, then it s drop.

Step 3: The step 1 and 2 repeated for all frame in video sequence.

The encoder transmits the encoded frame with its number and it would be used in decoder side to find the dropped frame. Fig. of The frame dropping sequence shows the frame dropping sequence.

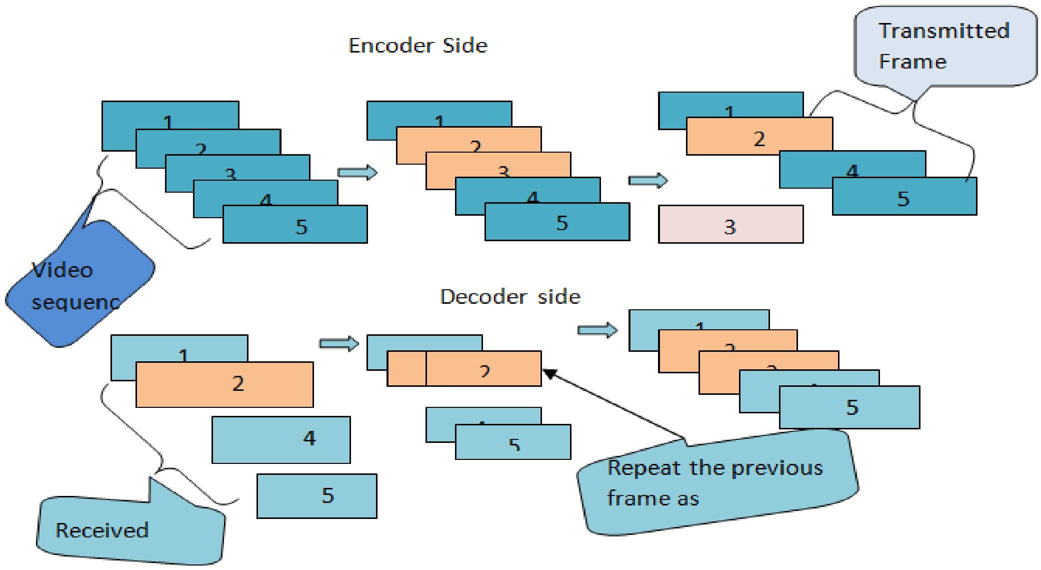

Fig 6: The frame dropping sequence

VII. Rate Control Scheme

It can be classified into two major categories: CBR control is used for the constant channel bandwidth video tx and VBR control for the variable channel bandwidth Transmission. These schemes are usually resolve two main problems. First is how to allocate proper bits to each coding unit according to the buffer status, i.e., rate allocation, and then second is how to adjust the encoder parameters to properly encode each unit with the allocated bits, i.e., quantization parameter adjustment.

When the output bit rates not match with target bit estimation the rate control provide new quantization step size to encode the data with new quality to be match with target bit rate.

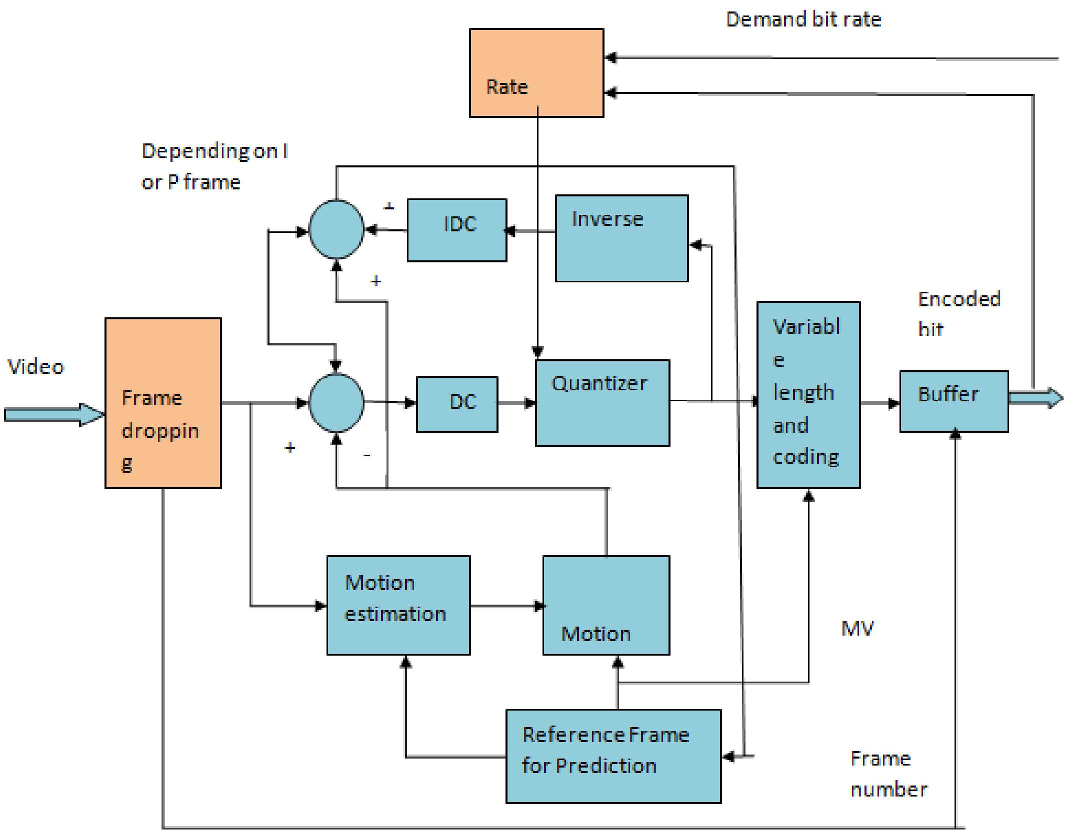

Fig 7 The proposed rate control scheme

VIII. Proposed Bit-Rate Control Requirements:

8.1 Complexity Estimation

The MAD used as the prediction error which is a convenient surrogate for this purpose as follows:
$MAD = \sum_{ij} \left| source_{i,j} - prediction_{i,j} \right|$
This MAD is an inverse measure of predictor's accuracy and the temporal similarity of adjacent pictures.

8.2 Virtual Buffer Model

Change in the fullness of the virtual buffer is difference between the total bits encoded into the stream, it assumes less a constant removal rate to equal the bandwidth.

8.3 Gop Bit Allocation

Based on the demanded bit rate and the current fullness of the virtual buffer, a target bit rate for the entire group of pictures (GoP) are determined, and QP for the GoP's
I-frame and before P-frame is determined. The GoP Target is fed into the next block for detailed bit allocation to smaller basic units or to pictures.

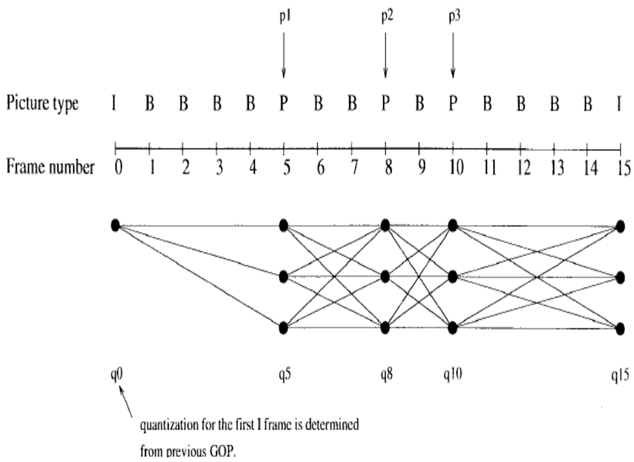

FIG 8: An example of GOP structure with corresponding quantization trellis diagram for the case of three quantization values.

8.4 Basic Unit Bit Allocation

The "Basic Unit of this approach, rate control may be pursued to different levels of granularity, such as picture, slice, MB row or any contiguous set of MBs. That level is referred to as a "basic unit" at which rate control is resolved, and for which distinct values of QPs are calculated.

8.5 Motion Estimation And Compensation

The uncompressed video sequence input undergoes temporal redundancy reduction by exploiting similarities between neighboring video frames as used Temporal redundancy arises since the differences between two successive frames are usually similar, especially for high frame rates, because the objects in the scene can only make small displacements. With motion estimation, the difference between successive frames can be made smaller since they are more similar. Compression is achieved by predicting the next frame relative to the original frame.

The performance of the proposed compression system was evaluated by using a popular quantitative measure of image quality known as the peak signal-to-noise ratio (PSNR), which is defined as: $PSNR(dB) = 10log_{10} \frac{(2^n - 1)^2}{MSN}$

Where n is the number of bits per image sample and MSE is the Mean Squared Error between the distorted frame and the original frame.

$$MSE = \frac{1}{W \times H} \sum_{r=0}^{H-1} \sum_{c=0}^{W-1} (I(r,c) - I\hat{}(r,c))^2$$

This ratio represents the size of the original uncompressed video to the size of compressed video.

$$\text{CR} = \frac{\text{Uncompressed file size}}{\text{Compressed file size}}$$

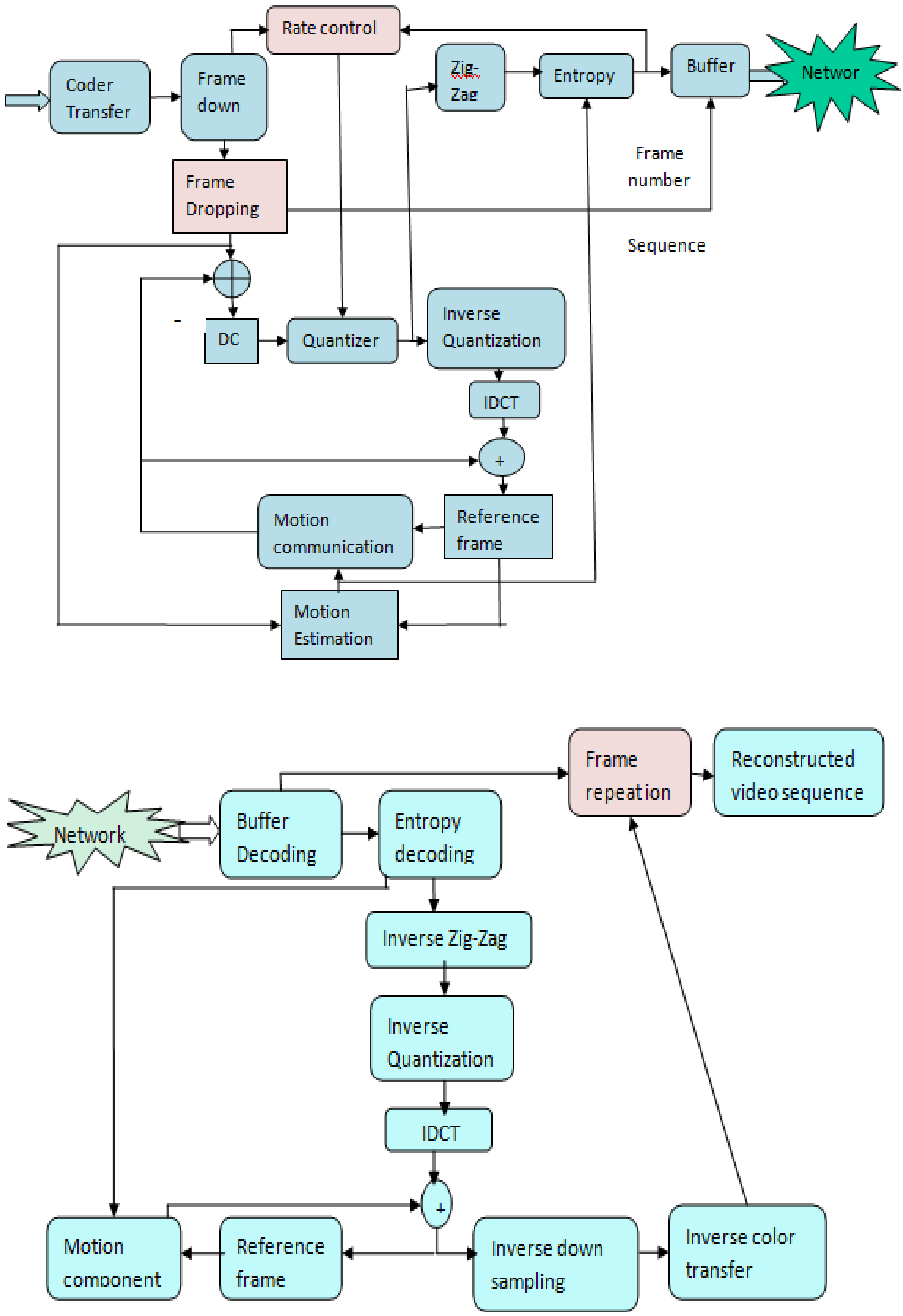

Fig 9: Block diagram of the proposed system

Table1:

GOP	Quality	Bit rate	CR	PSNR	Encoding Time	Decoding Time
60	90	0.0293	75.8648	83.4144	67.5355	52.4253
	70	0.0377	75.8648	83.4144	69.4913	57.0152
	50	0.0527	75.8648	83.4144	66.1882	54.8999
	30	0.0879	75.8648	83.4144	80.0011	54.7503
	10	0.2636	75.8648	83.4144	67.9754	55.9054
40	90	0.0293	75.8648	86.1599	92.9102	81.4423
	70	0.0377	75.8648	86.1599	96.8603	79.3174
	50	0.0527	75.8648	86.1599	89.5317	81.8240
	30	0.0879	75.8648	86.1599	97.4374	84.7729
	10	0.2636	75.8648	86.1599	94.6356	85.5683
30	90	0.0293	75.8648	86.0556	92.9102	81.4423
	70	0.0377	75.8648	86.0556	96.8603	79.3174
	50	0.0527	75.8648	86.0556	89.5317	81.8240
	30	0.0879	75.8648	86.0556	97.4374	84.7729
	10	0.2636	75.8648	86.0556	94.6356	85.5683
20	90	0.0293	75.8648	86.1412	126.3140	87.6253
	70	0.0377	75.8648	86.1412	125.7871	100.0402
	50	0.0527	75.8648	86.1412	103.7997	98.7241
	30	0.0879	75.8648	86.1412	159.8561	79.5927

In this project we have maintained the constant compression ratio whatever our varying like GOP and Quality. And bit rate will change when Quality change, and then maintain PSNR change only when GOP (group of pixel) will change.

For example: see table in this

1. GOP is equal to 60, quality (90, 70, 50, 30 and 10), corresponding bit rates (0.0293, 0.0377, 0.0527, 0.0879 and 0.2636), PSNR is 83.4144.
2. GOP is change then PSNR also change, in this GOP is 40 then PSNR is 86.1599.

But in this GOP decreases PSNR will increases and in the GOP quality decreases Bit rate increases. Encoding and decoding time depends on processor time.

We can see figure 5.1 it is which frame you taken, figure 5.2 shows how deviate the original frame and figure 5.3 is a labeled frame this is which object you want detected. But in this project main advantage is you're increasing GOP frames up to 60 no data will loss, we have compressed any frame 256*256 pixel range only. We can observed graphs also see fig 5.4 Quality versus compression Ratio. And also see figure 5.5 Quality versus Bit rate and PSNR

Fig 9.1: original frame

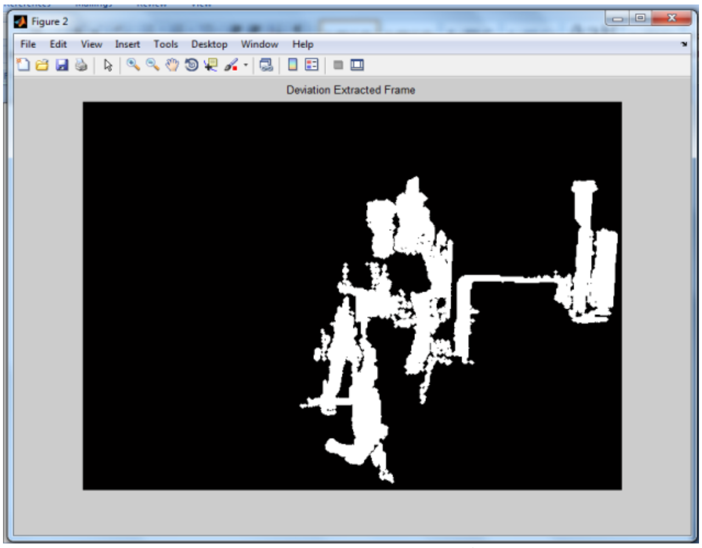

Fig9.2: deviation extracted frame

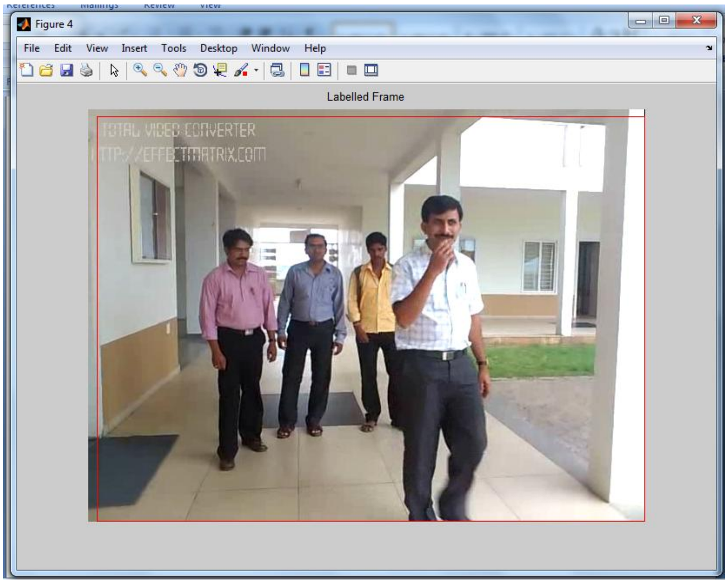

Fig 9.3: labeled frame

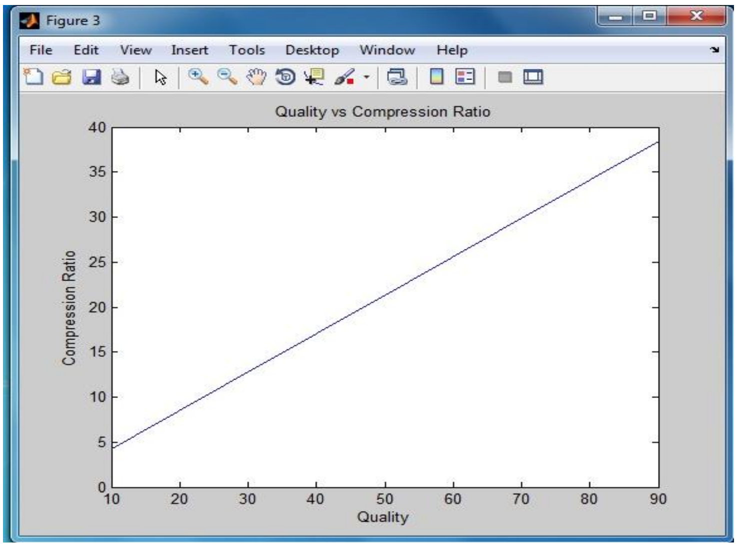

Fig 9.4: quality vs. compression ratio

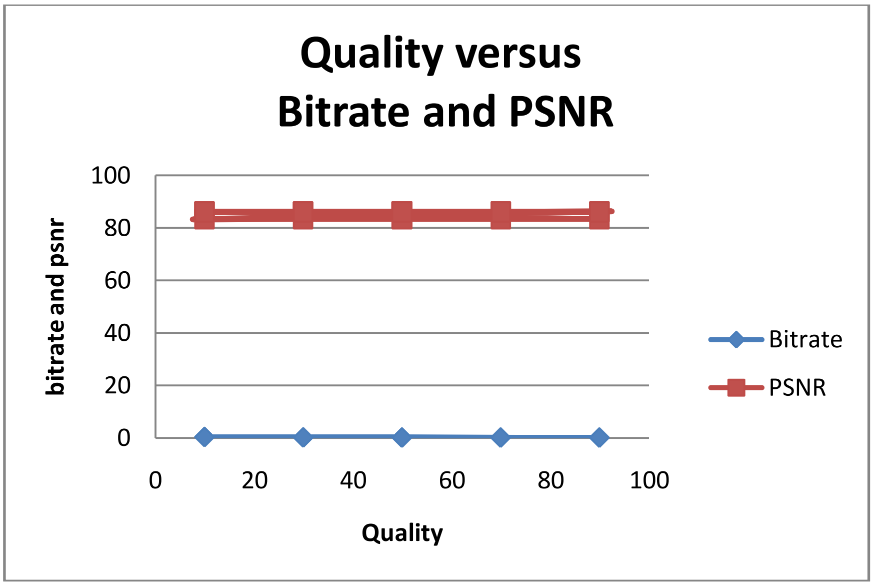

Fig 9.5: quality vs.bitrate and PSNR

IX. Conclusion

In this we have to observed GOP on video, in this GOP increases PSNR decreases and bit rate minted ,in the GOP we take some Qualities (90,70,50,30,10) in this bit rate is constant it is main advantage.

Future Scope

In this we have developed up to 60 GOP without data losses, improve more GOP without data losses in real time.

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